ENCLOSURE 2

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

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Licensee:	Union Electric Company
Facility:	Callaway Plant
Location:	Junction Hwy. CC and Hwy. O Fulton, Missouri
Dates:	August 18-22, with inoffice inspection continuing through December 19, 1997
Lead Inspector:	John E. Whittemore, Senior Reactor Inspector, Maintenance Branch
Inspectors:	Paul C. Gage, Senior Reactor Inspector, Maintenance Branch Claude E. Johnson, Senior Reactor Inspector, Maintenance Branch William M. McNeill, Reactor Inspector, Maintenance Branch Charles J. Paulk, Senior Reactor Inspector, Maintenance Branch Kathy Weaver, Resident Inspector, Projects Branch F
Accompanying Personnel:	Thomas A. Bergman, Operations Engineer, Office of Nuclear Reactor Regulation S. A. Eide, PRA Consultant, Idaho National Engineering Laboratory
Approved By:	Dr. Dale A. Powers, Chief, Maintenance Branch Division of Reactor Safety

ATTACHMENT: Supplemental Information

EXECUTIVE SUMMARY

Callaway Plant
NRC Inspection Report 50-483/97-11

This inspection included a review of the licensee's implementation of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," [the Maintenance Rule]. This report covers a 1-week onsite period of inspection for six inspectors with continuing inoffice inspection.

Operations

- Generally, operators had adequate knowledge of the Maintenance Rule and their responsibilities for implementing the Maintenance Rule. Some operators believed that the equipment train out-of-service probabilistic risk assessment matrix could be used when more than two structures, systems, and components were simultaneously removed from service even though it was not intended for those situations (Section O4.1).

Maintenance

- The licensee's scoping effort was conservative and thorough. No scoping deficiencies were identified (Section M1.1).
- The licensee's program exhibited weak performance in the areas of safety-significance determination, performance criteria establishment, and expert panel deliberations (Section M1.2).
- The licensee's determination of structure, system, and component safety significance was not conservative and resulted in less stringent performance criteria and, therefore, less effective performance monitoring (Section M1.2).
- The licensee's failure to update the individual plant examination and unavailability performance criteria was a weakness (Section M1.2).
- The licensee's failure to establish a technical basis for the reliability performance criteria was identified as a weakness (Section M1.2).
- The licensee's periodic assessment was thorough and met the requirements of the periodic evaluation provision in 10 CFR 50.65(a)(3) (Section M1.3).
- The licensee's structures monitoring program was effective (Section M1.6).
- Multiple implementation problems occurred because of weak safety-significant system and component monitoring practices and policies (Section M1.6).

- The licensee's reliability evaluation of the low-pressure feedwater heaters did not demonstrate that preventive maintenance would assure the reliability of the feedwater heaters. This was identified as a violation (Section M1.6).

- The licensee's monitoring of containment process piping penetration isolation valves was nonconservative in that performance degradation would not be identified until a facility license limit was reached. This was identified as a violation (Section M1.6).

- The licensee's program did not contain adequate guidance on specific criteria to be used for functional failure determination. The licensee's failure to identify two functional failures of a high pressure safety injection pump mini-flow Recirculation Valve EMHV8814A and one functional failure of an Essential Service Water Heat Exchanger Cooling Outlet Valve EFV0090, resulting from poor programmatic guidance was identified as a violation (Section M1.6).

- The licensee's program did not rigorously evaluate the effectiveness of preventive maintenance to assure reliability of the mechanical seals for the heater drain pumps. This was identified as a violation (Section M1.6).

- Because of weak program requirements, the licensee had not completed evaluations for functional failures of the main steam safety valve and reactor coolant system code safety valves surveillance test failures (Section M1.6).

- The plant annunciator system classification as nonstandby system was erroneous and the performance criteria established for the system represented a weakness in monitoring the effectiveness of maintenance activities on the system (Section M1.6).

• The licensee had not evaluated the unavailability of structures, systems, and components against adequate measures pursuant to the requirements of Section (a)(2). The licensee had not demonstrated that the performance or condition of systems within the scope of 10 CFR 50.65 were being effectively controlled through the performance of appropriate preventive maintenance prior to placing the systems under Section (a)(2). The following two examples were identified as a violation (Section M1.6):

  - The licensee's program did not count surveillance time on the reactor protection system as unavailability when a function was unavailable.

  - The emergency diesel generators and residual heat removal system were not monitored for unavailability unless the plant was in Mode 1.

• The observed structures, systems, and components were generally in good material condition with the exception of certain fire protection equipment (Section M2).

- Self assessments were thorough and addressed areas of Maintenance Rule implementation, and the self assessments identified concerns and recommendations. The licensee's corrective actions appeared appropriate for the problems identified. However, the self assessments did not identify all of the problems identified by the NRC team (Section M7.1).

Engineering

- System engineers had sufficient knowledge of their assigned systems. The Maintenance Rule and probabilistic risk analysis knowledge level of individual system engineers was commensurate with their responsibilities as defined in the licensee's program (Section E4.1).

Report Details

Summary of Plant Status

The unit was at full power at the start of the inspection week. During the week, power was reduced to about 73 percent in response to core axial offset conditions.

I. Operations

O4 Operator Knowledge and Performance

O4.1 Operator Knowledge of the Maintenance Rule

a. Inspection Scope (62706)

The team reviewed the licensee's program to determine the responsibilities assigned to facility operations personnel. Licensed senior reactor operator personnel were interviewed to verify that their knowledge level was adequate to perform the tasks necessary to carry out those responsibilities.

b. Observations and Findings

The operator tasks associated with the Maintenance Rule included logging structures, systems, and components out-of-service and evaluating plant risk for planned and unplanned structures, systems, and components out-of-service events (failures).

In general, the operators had adequate knowledge of the Maintenance Rule and their responsibilities associated with the Maintenance Rule. A list of structures, systems, and components was available in Procedure ODP-ZZ-00002, "Equipment Status Control," Revision 14, Attachment 5, indicating which structures, systems, and components out-of-service events were to be tracked. Such outages were tracked on the equipment out-of-service log for Technical Specification structures, systems, and components and the workman's protection assurance (tagout) system for others.

The equipment train out-of-service probabilistic risk assessment matrix in Procedure ODP-ZZ-00002 provided guidance for evaluating the plant configuration risk from structures, systems, and components out-of-service while the plant was at power. Operators indicated that they used the matrix mainly for the evaluation of emergent failures. For cases where two structures, systems, and components on the matrix were taken out-of-service, the operators' understanding of the matrix was good. However, for hypothetical cases involving three structures, systems, and components, several operators indicated that they would evaluate such a case by evaluating all combinations of two structures, systems, and components. The use of the risk matrix to evaluate these triple combinations was inappropriate because the matrix was not capable of evaluating risk of more than two structures, systems, and components out-of-service at one time.

The list of structures, systems, and components out-of-service during the period May 15 through August 15, 1997, was examined to determine if any potentially high-risk configurations occurred. Two instances were noted, but in both cases a separate risk evaluation had been requested before the configuration occurred. In each case, the risk evaluation determined a maximum allowable duration for the configuration (Probabilistic Risk Analysis Evaluation Reports 97-086 and -087).

c. Conclusions

In general, the operators had an adequate knowledge of the Maintenance Rule and their responsibilities for implementing the Maintenance Rule. Some operators believed the equipment train out-of-service probabilistic risk analysis matrix could be used when more than two structures, systems, or components were to be removed from service even though it was not intended for those situations. A limited review of actual experience indicated that correct actions were taken to obtain additional risk evaluations for these situations.

II. Maintenance

M1 Conduct of Maintenance

According to the Updated Final Safety Analysis Report, Appendix 3A, the licensee fully subscribed to Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," which endorsed NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants."

M1.1 Scope of the System, Structure, and Component Functions Included Within the Maintenance Rule (62706)

The team reviewed the licensee's procedure for initial scoping, the Callaway Final Safety Analysis Report, and emergency operating procedures. The team developed an independent list of structures, systems, and components that they determined should be included within the scope of the licensee's Maintenance Rule program in accordance with the scoping criteria in 10 CFR 50.65(b). The team used this list to determine if the licensee had adequately identified the structures, systems, and components or functions that should have been included in the scope of the Maintenance Rule program.

The team did not identify any required structures, systems, and components that were omitted from the scope of the program developed to implement the requirements of 10 CFR 50.65. The licensee's scoping effort was conservative and thorough.

M1.2 Safety or Risk Determination

a. Inspection Scope (62706)

The team reviewed the methods and calculations that the licensee had established for making the required safety determinations, including the probabilistic risk assessment and associated modeling. Additionally, the team reviewed the licensee's safety determinations for the functions that were reviewed in detail during this inspection. As part of the inspection team's review, expert panel members were interviewed and minutes of all panel meetings from 1994 - July 1997 were reviewed. Finally, the team reviewed a sample of nonrisk-significant structures, systems, and components to assess if the safety significance was adequately established.

b. Observations and Findings

b.1 Safety or Risk Significance Determination Methodology

The licensee's process for establishing the safety significance of structures, systems, and components within the scope of the Maintenance Rule was documented in Procedure PDP-ZZ-00020, "Maintenance Rule Program," Revision 2. For structures, systems, and components that were modeled in the licensee's individual plant examination, three importance measures of risk reduction worth, risk achievement worth, and cut sets comprising 90 percent of the core damage frequency were used to evaluate safety significance, as suggested in the guidance document NUMARC 93-01.

If a structure, system, or component met only one of the importance measuring criteria, then the expert panel decided whether to reduce the particular structure, system, or component safety-significance to low or nonrisk-significant. In four cases, the expert panel decided to downgrade the risk significance of the structures, systems, and components. The basic events in the individual plant examination that resulted in high importance for three of those systems (main steam, main feedwater, and accumulator safety injection) were common cause failure events, mainly common cause failures of valves in more than one train. The licensee representative indicated that those events were extremely unlikely to occur and that the uncertainties in the probabilities of occurrence were large. Therefore, the expert panel decided that those systems could be downgraded to a nonrisk significant classification.

The team considered these arguments to be inappropriate because common cause events have occurred at nuclear power plants and are an important consideration in probablistic risk assessment structure, system, and component modeling. The low probabilities of such events were already factored into the importance measures, and uncertainties were not considered in the three importance measures used. The licensee also neglected to consider the critical safety functions performed by the structure, system, and component, which, according to the NUMARC 93-01 guidance, can also be used for structure, system, and component risk-significance determination. The team considered the downgrading of the three systems to low-safety significance to be inappropriate and that the main steam, main feedwater, and accumulator safety injection systems should have been classified as high-safety significance.

For containment systems and other structures, systems, and components that were not modeled in the individual plant examination, the expert panel decided the risk significance. The expert panel decided that containment spray, containment isolation, and containment cooling were not risk-significant. The licensee reviewed the Level 2 portion of the individual plant examination to estimate how important these systems were to accidents leading to potentially large releases of radioactive material to the atmosphere. Because most large release scenarios involved steam generator tube ruptures or nonisolable loss-of-coolant accidents, which bypassed the containment systems, the expert panel decided these three containment systems were not risk-significant. If the licensee had performed a detailed Level 2 analysis with a low truncation cut-off frequency and actually calculated importance measures that focused on large releases, in addition to core damage frequency importance calculations, it is likely that some, or all, of these three containment systems would meet importance measuring criteria for classification as risk-significant. As with the individual plant examination modeled systems, the licensee did not consider the performance of critical safety function contributions by these systems, which is suggested by the NUMARC 93-01 guidance.

b.2 Performance Criteria

The licensee's approach to establishing performance criteria was outlined in Procedure PDP-ZZ-00020. In general, unavailability performance criteria were based on 100 percent of the test and maintenance unavailability hours used in the individual plant examination. The team noted that these data were collected for the period 1987 through mid 1990, and the individual plant examination had not been updated since its 1992 submittal. It appeared to the team that plant performance with respect to structure, system, and component unavailability hours had improved considerably since the late 1980s. Therefore, the use of unavailability performance criteria based on old plant data, rarely resulted in those performance criteria being challenged. The team considered the use of these late 1980s data and an individual plant examination that had not been updated to be a weakness in the licensee's implementation of the Maintenance Rule.

Reliability performance criteria generally were not based on individual plant examination reliability assumptions. The licensee generally used less than or equal to one maintenance preventable functional failure for risk-significant structures, systems, and components and less than or equal to two maintenance preventable functional failures for nonrisk-significant structures, systems, and components. There were some exceptions. This approach did not adequately reflect variability in estimated numbers of demands and tests for structures, systems, and components. The licensee had not performed an individual plant examination sensitivity study to determine whether the reliability performance criteria were commensurate with safety. Such a study was necessary to demonstrate that performance criteria not based on the individual plant examination are commensurate with safety.

During the week of the inspection, such a study was performed and the results were presented to the team. The licensee's staff discussed that the increase in core damage frequency resulting from all of the reliability performance criteria being input to the individual plant examination would not be realistic. At the end of each 18-month cycle period, the licensee would input the actual plant performance data (unavailability and reliability) into the individual plant examination. The licensee's representative stated that if a significant increase in predicted core damage frequency resulted, then the performance criteria would be modified. This process was described in Procedure PDP-ZZ-00020, Revision 2. However, the use of reliability performance criteria that had not been validated to be commensurate with safety could result in less than adequate monitoring. This was identified as a weakness.

b.3 Expert Panel Observations

The licensee's expert panel charter and guidelines were contained in Procedure PDP-ZZ-00020. Panel responsibilities included: review and approval of scoping, safety significance evaluations, establishing performance criteria, determination of maintenance preventable functional failures, and approval of structure, system, and component reclassification as Category (a)(1) or (a)(2). The expert panel was an active part of the licensee's implementation of the Maintenance Rule, and it had broad responsibilities. However, as indicated in other parts of this inspection report, the team believed the expert panel's processes for downgrading structures, systems, and components to low-risk significance and evaluating maintenance preventable functional failures were flawed.

c. Conclusions

There were occurrences of weak performance in the programmatic areas of safety significance determination, performance criteria establishment, and expert panel deliberations. The determination of structure, system, and component risk-significance was not conservative and resulted in less stringent performance criteria and, therefore, less effective performance monitoring. Failure to update the individual plant examination and unavailability performance criteria was a weakness. Also, the failure to validate the reliability performance criteria was a weakness.

M1.3 Periodic Evaluation

a. Inspection Scope (62706)

The team reviewed the licensee's periodic evaluation for Cycle 8 (May 11, 1995, through November 11, 1996), dated July 14, 1997, to determine whether it was performed in accordance with the requirement of 10 CFR 50.65(a)(3).

b. Observations and Findings

The licensee's practice was to perform a periodic assessment following the completion of each refueling outage. The periodic assessment included an evaluation of the performance of structures, systems, and components against goals or performance criteria, as appropriate. The periodic assessment described how industry operating experience was taken into account during the course of a fuel cycle and when performance criteria or goals were exceeded. The evaluation also included discussion and evaluations for all plant trips, unplanned safety system actuations, maintenance preventable functional failures, and the effectiveness of corrective actions. The periodic assessment concluded that reliability and availability of structures, systems, and components of high-safety significance were balanced because performance criteria were met.

c. Conclusions for Periodic Evaluation

The licensee's periodic assessment was thorough and met the intent of the periodic evaluation requirement in 10 CFR 50.65(a)(3).

M1.4 Balancing Reliability and Availability

a. Inspection Scope (62706)

Paragraph (a)(3) of the Maintenance Rule requires that adjustments be made, where necessary, to assure that the objective of preventing failures through the performance of preventive maintenance is appropriately balanced against the objective of minimizing unavailability due to monitoring or preventive maintenance. The team reviewed the Cycle 8 periodic assessment that conducted this evaluation.

b. Observations and Findings

The licensee's approach to balancing structure, system, and component reliability and unavailability was described in Procedure PDP-ZZ-00020. The planning support group and engineering organization had the responsibility for monitoring structure, system, and component performance to ensure that reliability and unavailability were balanced. In general, if a structure, system, or component did not exceed its unavailability and reliability performance criteria, then the structure, system, or component performance was considered to be balanced.

c. Conclusions for Balancing Reliability and Availability

The licensee's approach to balancing structure, system, and component reliability and unavailability was acceptable. However, since structures, systems, and components had rarely exceeded performance criteria, there were limited opportunities for balancing considerations.

M1.5 Plant Safety Assessments Before Taking Equipment Out-of-Service

a. Inspection Scope (62706)

The team reviewed the licensee's procedures and discussed the process with applicable personnel, including expert panel members, operators, schedulers, and the Maintenance Rule coordinator. A sample of plant configuration changes that resulted from schedule changes and equipment failures was identified and then reviewed to evaluate the licensee's assessments of changes in risk that resulted from the configuration changes.

b. Observations and Findings

The licensee's process for evaluating plant risk before taking structures, systems, and components out-of-service was documented in the following procedures:

APA-ZZ-00310	Workman's Protection Assurance and Caution Tagging, Revision 11
ODP-ZZ-0002	Equipment Status Control, Revision 14
PDP-ZZ-00006	Preparation of the Daily and Weekly Schedule, Revision 8
PDP-ZZ-00015	Shutdown Safety Management, Revision 1
PDP-ZZ-00020	Maintenance Rule Program, Revision 2

The equipment train out-of-service probabilistic risk analysis matrix, contained in Procedure ODP-ZZ-00002, was used by planners to identify potentially high-risk configurations resulting from the removal of structures, systems, and components from service while the plant was at power. Also, the same matrix was used by operators to evaluate the risk associated with configuration changes due to equipment failures. The matrix identified both Technical Specification limiting conditions and high risk conditions. Planners used the protected-train concept in their 12-week schedule, and generally did not allow multiple outages of high-safety significant structures, systems, and components.

The equipment train out-of-service probabilistic risk analysis matrix could be used only for combinations of two structures, systems, and components planned to be out-of-service at the same time. Not all high-safety significant structures, systems, and components were listed on the matrix (reactor protection system and engineered safety features actuation system were two examples), but a few low-safety significant structures, systems, and components were added (e.g., containment and service water systems). The matrix notes indicated that the licensee did not list on the matrix high-safety significant structures, systems, and components that were not intended to be taken out-of-service or had very short allowable outage times. Licensee representatives stated that the short allowable outage times would result in sufficient attention to returning equipment to service as soon as possible.

The process used to assess the risk associated for plant shutdown conditions was contained in Procedure PDP-ZZ-00015, and appeared to be the standard industry-recommended approach for assessment of shutdown risk conditions.

The list of structures, systems, and components out-of-service during the period May 15 through August 15 was examined to determine if any undesirable potentially high-risk configurations had occurred. Two instances were noted, but in both cases a separate risk evaluation had been requested before the configuration occurred. In both cases the risk evaluation determined a maximum allowable duration for the configuration, which was met.

c. <u>Conclusions for Safety Assessments</u>

The licensee's analytical approach for assessing plant risk resulting from multiple structure, system, and component outages was appropriate. The method of assessing plant risk while at power, by use of the equipment train out-of-service probabilistic risk analysis matrix, was adequate. The methodology for assessing the change in risk during shutdown conditions met the industry guidance.

M1.6 Goal Setting and Monitoring and Preventive Maintenance

a. Inspection Scope (62706)

The team reviewed program documents and records in order to evaluate the process that had been established to set goals and monitor under paragraph (a)(1) and to verify that preventive maintenance was effective under paragraph (a)(2) of the Maintenance Rule. The team also discussed the program with the Maintenance Rule coordinator, system engineers, plant operators, and schedulers.

The team reviewed the structures, systems, and components listed below to verify: that goals or performance criteria were established with safety taken into consideration; that industry-wide operating experience was considered for goal setting, where practical; that appropriate monitoring and trending were performed; and, that corrective action was taken when a structure, system, or component function failed to meet its goals or performance criteria, or experienced a maintenance preventible functional failure.

Annunciators
Circulating water system
Containment cooling system
Containment spray system
Essential service water system
Feedwater system
Instrument/compressed air system
Reactor protection system
Site structures
Auxiliary feedwater system
Condensate system
Containment isolation system
Electro-hydraulic control system
Feedwater heater drains system
High pressure safety injection system
Main steam system
Reactor coolant system

The team peripherally reviewed the fire protection and plant computer systems because the monitoring schemes for the two systems were changed the week prior to the inspection. The plant computer was moved to Category (a)(2) and the fire protection system was moved to Category (a)(1). The fire protection system was the only system in Category (a)(1) at the time of the inspection.

b. Observations and Findings

The team reviewed the licensee's program for monitoring the effectiveness of maintenance on site structures. The program had attributes that adequately scoped structures into the program, evaluated and determined risk significance of structures, and developed performance criteria based on condition monitoring. The team also noted that failure to meet performance criteria would result in evaluation, possible goal setting, and monitoring in Category (a)(1). The justifications for excluding certain structures from the program were adequate. Baseline inspections had been performed on more than half of the in-scope structures and the schedule completion of baseline inspections was the end of the present cycle in the spring of 1998. A sample review of inspection records indicated that baseline inspections were identifying deficiencies and the deficient items were entered into the corrective action system.

The team's review of the licensee's monitoring of the systems listed below indicated that they were adequately monitored in accordance with the licensee's program and the Maintenance Rule. Also, a historical review of failures associated with the systems indicated that the systems had been properly evaluated and characterized during implementation of the licensee's program.

- Auxiliary feedwater system
- Circulating water system
- Containment spray system
- Electro-hydraulic control system
- Feedwater system
- Instrument/compressed air system

The team identified specific Maintenance Rule issues with the systems and components addressed below.

The condensate system was nonrisk-significant and monitored using plant-level performance criteria. There had been several tube failures of various feedwater heaters over the past 4 years. None of these failures had been evaluated as a functional failure. (No requirement existed for such evaluation.) The corrective action for the tube failures was to isolate the heater string and plug the affected tubes. An improved design for the tube bundles was installed in the highly-degraded low-pressure Feedwater Heaters 2A, 2B, and 2C, and additional tube bundle replacements were scheduled. The licensee had attempted to reduce the probability of on-line tube failures in the older designed tube bundles using eddy current testing techniques and plugging or sleeving tubes, which had excessive wall thinning. Consequently, feedwater heater tube failures were not classified as functional failures and the time at reduced power was not included in accounting for unplanned capability loss. The tube failures were treated as a planned activity even though the subsequent energy losses for the plant were not scheduled four weeks in advance as referenced in the guidance provided in NUMARC 93-01. Therefore, the heaters were essentially in a run to failure mode because evaluation of the feed heaters was not demonstrating that preventive maintenance would assure the reliability of the low-pressure feedwater heaters. This was an example of a violation of 10 CFR 50.65(a)(2) (50-483/9711-01).

The team identified a functional failure of the containment cooling system that was not evaluated during the historical system performance review. Suggestion Occurrence Solution 94-0050 was initiated for a surveillance testing failure of the containment coolers because of silting in the tubes. Licensee personnel stated that the cooler flows, although less than the surveillance test requirements, were greater than requirements established in a design calculation. This was not consistent with a licensee representative's assertion that the most conservative parameter limits or values (safety, design, or administrative) were always used to determine if a functional failure had occurred. The team noted that the licensee's program did not contain guidance on specific criteria to be used for functional failure determination.

The scope of the containment isolation system included the equipment and personnel hatches, electrical penetrations, and containment isolation valves that did not receive an automatic closure signal. Process piping penetrations that received automatic closure signals were monitored with the system in which they were installed, but also collectively, as a pseudo system. The licensee used an Appendix J testing program to satisfy the requirements of the Maintenance Rule. The NRC staff concluded the licensee could use its 10 CFR Part 50, Appendix J, testing program to meet the Maintenance Rule requirements in part; however, an Appendix J testing program alone was not sufficient. To meet the intent of the Maintenance Rule, an Appendix J testing program would have to be modified or enhanced so that the effectiveness of maintenance on system components could be measured. The licensee's current program considered a failure or unacceptable degradation to be when an isolation valve's leakage exceeded the Appendix J Technical Specification limit of 0.6 L_a. Using this logic for the Maintenance Rule program requirements, a functional failure could only occur when a Technical Specification limit was exceeded. Therefore, the ability of preventive maintenance to assure the reliability of the containment isolation valves was not demonstrated. This was identified as an example of a violation of 10 CFR 50.65(a)2) (50-483/9711-01).

The team found two safety-related containment isolation valves (High Pressure Safety Injection Valve EMV0006, a spring loaded check valve; and Essential Service Water Valve EFHV0084, a motor-operated butterfly valve) where the as-left leakage rates were greater than the as-found leakage rates. This should have raised questions regarding the effectiveness of maintenance activities performed on these valves between the two tests. However, the licensee's Maintenance Rule program did not require any evaluation of the identified degradation in the performance of these valves.

Prior to Cycle 8, the essential service water Train B was in Category (a)(1) due to high unavailability. During Cycle 8, the essential service water Train B met the established goal to meet the unavailability and reliability criteria and was subsequently returned to Category (a)(2) at the beginning of Cycle 9. The team determined that the licensee had established appropriate goals for the essential service water Train B and adequately monitored against those established goals.

The team reviewed the suggestion occurrence solutions written against this system during the current Cycle 9. Suggestion Occurrence Solution 96-1894 documented that the yoke on Valve EFV0090, essential cooling water from component cooling water Heat Exchanger B, was cracked. There was a through wall crack on the plate bolted to the valve and the crack extended from the outside of the plate to the bore for the valve stem. The valve was locked in a throttling position and functioned to maintain the proper flow rate through the heat exchanger. The system engineer determined that this degradation amounted to a functional failure because of the possibility that total failure of the yoke could affect the valve safety function. If the yoke failed, there was a potential for the valve to rotate from its flow-balance position and, thus, not provide adequate flow to one or more of the safety-related essential service water flowpaths.

The team noted that the expert panel reviewed Suggestion Occurrence Solution 96-1894 and determined that the event was not a functional failure because the defect was identified and corrected before a loss-of-function occurred. NUMARC 93-01 provides guidance that a maintenance preventable functional failure is an unintended event or condition such that a structure, system, or component within the scope of the Maintenance Rule is not capable of performing its intended function, and the cause of the failure is attributable to maintenance or lack of maintenance activity. Valve EFV0090 was required to remain positioned during a design basis seismic event or an accident to assure the required essential cooling water flow to safety-related equipment.

The team reviewed Procedure PDP-ZZ-00020, Section 2.7, which defined a functional failure as "the failure of a structure, system, or component that prevents a system/train from performing one or more of its intended functions which, requires the structure, system, or component to be in the Maintenance Rule." The team determined that the definition of a functional failure in Procedure PDP-ZZ-00020 was inadequate and had contributed to an inappropriate determination that this condition was not a functional failure because the defect was identified and corrected before a loss of function occurred. The team also noted that within the licensee's program, if a condition or event was not identified as a functional failure by system engineering, it did not have to be evaluated by the expert panel to determine if a maintenance preventable functional failure occurred. The failure to adequately monitor the performance of safety-related components was an example of a violation of 10 CFR 50.65(a)(2) (50-483/9711-02).

The team notified licensee personnel of the inadequate procedure and the inappropriate determination. The licensee conducted an expert panel meeting on August 19, 1997, to reevaluate Suggestion Occurrence Solution 96-1894. A determination was made that the condition was a functional failure because the failure of the yoke could prevent the valve from performing its function. Licensee personnel stated an intention to evaluate further and determine if the failure was maintenance preventable. Also, a corrective action document was initiated to document the inadequate determination. A licensee representative further indicated an intention to clarify and improve Procedure PDP-ZZ-00020 so that unintended events and conditions of structures, systems, and components within the scope of the Maintenance Rule would be properly evaluated. Additionally, an intention was stated that suggestion occurrence solution reports, initiated since August 19, 1995, for failures would be re-evaluated to verify that there were no other inappropriate functional failure determinations.

The team found that five suggestion occurrence solution reports had been initiated for heater drain pump seal failures. The licensee initiated a modification to replace the seals with a different design because of accelerated aging from the system environmental chemistry conditions. Before the design change was completed, a decision was made to use the existing seals in a "run-to-failure" mode. The licensee did not consider the resultant seal failures as maintenance preventable functional failures. However, an evaluation to justify an inconsequential contribution to safety by the seals was not performed. According to NUMARC 93-01, Section 9.3.3, an evaluation of contribution to safety should be performed when a structure, system, or component is designated as "run-to-failure." Failure to evaluate the reliability of the seals did not demonstrate that preventive maintenance was assuring the reliable performance of the heater drain pumps. This was an example of a violation of 10 CFR 50.65(a)(2) (50-483/9711-01).

The team identified that the standby functions of the feedwater regulating valves and compressed air system nitrogen accumulators were not clearly identified and addressed in the licensee's Maintenance Rule program. As a result, there were no specific performance criteria established for these standby functions. However, the team determined that the performance criteria established for the feedwater system were sufficient for the licensee's monitoring of these functions.

The high pressure (intermediate) coolant injection system was designated nonrisk-significant standby and monitored in Category (a)(2). The team reviewed several suggestion occurrence solution reports and questioned the disposition of two:

- Suggestion Occurrence Solution 97-0963 identified on June 4, 1997, that Valve EMHV8814A, mini-flow recirculation, failed to open up on remote manual demand during Surveillance OSP-EM-V001A. The valve was normally positioned open and did not receive a safety injection signal to open, but could be operated by a hand switch from the control room. The purpose of the mini-flow recirculation valve was to provide system recirculation cooling during shutoff head operating conditions of a high pressure coolant injection pump.

- Suggestion Occurrence Solution 97-0717 was initiated on June 11, 1997, when Valve EMHV8814A was inadvertently closed and could not be reopened for about 1 minute, during troubleshooting activities when a technician inadvertently shorted contacts. The work activity was associated with determining why the valve would not open upon remote manual demand. Review of Suggestion Occurrence Solution 97-0717 indicated that this event was not considered, as required by Procedure PDP-ZZ-00020, to be a functional failure or maintenance preventable functional failure.

The high pressure coolant injection system function to provide borated cooling water to the core during an accident could be jeopardized by failure of the valve to open on demand. The justification for not classifying the first failure as a functional failure was because an equipment operator was available at the valve to manually open it. The second event was classified as personnel error and was not considered for functional failure. Neither justification provided an adequate basis for not considering the possibility of a functional failure. Also, in that a maintenance personnel error initiated the second event, any loss-of-function was maintenance preventable. Both of these events should have been designated functional failures and subsequently evaluated for classification as maintenance preventable functional failure. This was an example of a violation of 10 CFR 50.65(a)(2) (50-483/9711-02).

The main steam system was designated as standby, nonrisk-significant, and monitored using reliability criteria. The team noted that the critical function of the auxiliary feedwater system, as delineated in the Final Safety Analysis Report, was dependent on the availability of the main steam system. Therefore, as stated in Section M1.2.b.1, the nonrisk significant classification for the main steam system did not meet the intent of the guidance specified in NUMARC 93-01, Section 9.3.1.

A review of suggestion occurrence solution reports for the main steam system identified two occurrences documented in Suggestion Occurrence Solutions 96-1247 and 95-0508, that reported main steam safety valves as-found set pressures outside the acceptance criteria, as specified in the Technical Specifications. The first occurrence in the spring 1995 identified 14 of 20 valves that did not meet the criteria. The second occurrence involved only 1 valve identified on October 10, 1996. The team found that for each test failure corresponding suggestion occurrence solution report, site licensing screened the report and determined that there was no potential for functional failure of the main steam safety valves. Apparently, as a result of licensing's preliminary determination of no potential functional failure, the appropriate system engineer evaluation for functional failure was not performed. However, when questioned, a licensee representative indicated that evaluations were continuing.

The team noted that in accordance with the licensee's program, if a functional failure determination was not made by system engineering, then a maintenance preventable functional failure evaluation would not be performed by the expert panel. The team determined that the 1995 failures occurred prior to the effective date of the Maintenance Rule and the actions taken by site licensing resulted in no evaluation by system engineering for functional failure determination. This allowed practice brought into question the adequacy of the process for performing Maintenance Rule activities associated with functional failure determination. Furthermore, the 14 main steam system test failures in 1995 were not evaluated as a possible reason to consider goal setting when the Maintenance Rule became effective on July 10, 1996. The team found this to be another example of the lack of consistency in making functional failure determinations because of poor program guidance and a lack of specific performance criteria to determine that a functional failure had occurred. In addition, the licensee had not obtained data from the testing vendor to evaluate the cause of the test failures.

The annunciator system was classified as a nonstandby system, and evaluated against specific performance criteria involving the number of operable field or logic power supplies for the system. The team noted that the plant had sustained several annunciator problems over the past 5 years, including a recent (July 19, 1997) onsite lightning strike that caused a loss of most control room annunciators for more than 15 minutes. Corrective Action Document Suggestion Occurrence Solution 97-0852, which was initiated to determine the cause and identify corrective actions, remained open.

The team observed that none of the past failures had been classified as functional failures. The system performance criteria were less than three simultaneous field power supply failures or less than seven logic power supply failures. A licensee representative agreed that the criteria for determining a functional failure of the annunciator system was consistent with the basis for declaring an emergency action level (unusual event) for the plant. The representative stated that loss of three field power supplies would result in imminent loss of all annunciators within about 15 minutes, due to the design limitations on the remaining field power supply. However, other personnel indicated that a loss of any logic power supply would result in a reduction from full annunciator capability. The team considered the performance criteria established for the plant annunciator system to represent a weakness in monitoring the effectiveness of maintenance activities associated with the system.

Procedure PDP-ZZ-00020 defined a standby system as one not operating and only performing its intended function when initiated by either an automatic or manual demand signal. This was consistent with the definition found in Appendix B of NUMARC 93-01. Regulatory Guide 1.160, Section 1.6, states, in part, that if the system only performs its intended function when initiated by either an automatic or manual demand signal, the system is in standby. The defined functions of the annunciator system was to alert the operator to conditions that required his attention, and to interface alarm signals to the plant computer. The team determined that the annunciator system was erroneously classified as a nonstandby system.

The reactor protection system was designated as risk-significant and monitored for reliability and unavailability at the train level. The performance criteria were no maintenance preventable functional failures per cycle and unavailability of 12 hours per train per cycle. The team noted spurious reactor trips generated either by equipment or operator-induced failures were not considered failures with respect to the designated reactor protection system functions, as documented in Administrative Procedure APA-ZZ-00303, "Classification of Systems," dated July 22, 1997. The team determined that the licensee's program did not provide an appropriate method to determine if spurious plant trips could be attributed to maintenance-related activities.

Licensee representatives stated that even though trains and/or channels were taken out-of-service for routine surveillances, the risk associated with these systems did not change. The licensee provided data which showed that over 200 hours of routine surveillance activities were performed per channel per cycle. The licensee's program did not consider the train or channel to be unavailable during surveillance activity, but considered that only corrective or nonsurveillance maintenance activities would render the train or channel unavailable. The reactor protection system was not considered unavailable as long as a train function was not inhibited. The team reviewed corrective action documents associated with the reactor protection system and determined that there was 1 hour of unavailability for Train B of the reactor protection during Cycle 8. The Maintenance Rule program periodic assessment for Cycle 8 had documented 0 unavailable hours for the reactor protection system.

Licensee representatives desired to take credit for an ability to expeditiously recover the affected train or channel during surveillance activities. The team observed that some restoration procedures were complex and required multiple switch and control manipulations to return the channel or train to service. Appendix B of NUMARC 93-01, states, in part, that a system that is required to be available for automatic operation must be available and respond without human action, otherwise, the system is said to be unavailable. Regulatory Guide 1.160 states that maintenance includes not only preventive and corrective maintenance activities, but also surveillance activities. The licensee's Procedure POP-ZZ-00020 indicated that vulnerability performance criteria was set at 100 percent of the test and unavailability hours used in the individual plant examination. However, the licensee did not count unavailability resulting from surveillance testing against the performance criteria. The team considered the licensee's practice of not monitoring structure, system, or component unavailability during surveillance activities, to not meet the intent of the Maintenance Rule. The failure to evaluate the unavailability of safety-significant functions during surveillance of the affected structures, systems, and components was an example of a violation of 10 CFR 50.65(a)(2) (50-483/9711-03).

The team observed that following July 10, 1996, (effective date of the Maintenance Rule) and until March 17, 1997, the licensee monitored the unavailability of the emergency diesel generators and the residual heat removal system only when the plant was in Mode 1. The expert panel eventually determined that, in order to evaluate the effectiveness of maintenance for structures, systems, and components, unavailability had to be monitored in any mode when the structure, system, or component functions were required to be available. Thus, the March 1997 adjustments were made to the monitoring schemes for these two systems. Although, the licensee identified and corrected this condition, the team determined, due to the programmatic aspect associated with the licensee's unavailability evaluation of safety-significant structures, systems, and components, that this constituted a second example of a violation of 10 CFR 50.65(a)(2) (50-483/9711-03).

During review of the reactor coolant system, the team observed that a pressurizer code safety valve had lifted outside of the allowable band during the previous testing, in the fall of 1996. The team noted that the licensee had not evaluated the out-of-tolerance results for functional failures. System engineering could not provide the team with any quantifiable values for functional failures of either the code safety valves or the power-operated relief valves. The team found that this was another example of the lack of consistency in making functional failure determinations because of poor program guidance.

c. Conclusions

Multiple implementation problems occurred because of weak safety-significant system and component monitoring practices and policies.

The guidance on specific criteria to be used for functional failure determination was not adequate. Because of weak program requirements, the licensee's program did not evaluate main steam safety valve and reactor coolant system code safety valve surveillance test failures for functional failures. The licensee's failure to identify three functional failures in two safety-related systems was a violation.

The monitoring program for containment process piping penetration isolation valves was nonconservative in that performance degradation would not be identified until a facility license limit was reached. Because of an erroneous plant annunciator system classification as nonrisk-significant/nonstandby, the established performance criteria represented a weakness in monitoring the effectiveness of maintenance activities on the system. The licensee's program did not count reactor protection system surveillance time as unavailability when the function was unavailable. The emergency diesel generators and residual heat removal system were not monitored for unavailability unless the plant was in Mode 1. The two items above were examples of a violation.

M2 Maintenance and Material Condition of Facilities and Equipment

a. Inspection Scope (62706)

In the course of verifying the implementation of the Maintenance Rule, the team performed in-plant walkdowns to examine the material condition of accessible portions of the following systems:

- Auxiliary feedwater
- Electro-hydraulic control system
- Essential service water system
- Essential service water pump house structure
- Feedwater heater extraction steam
- Feedwater pumps, feedwater control, and bypass valves
- Fire protection system pump house structure
- Instrument air system

b. Observations and Findings

The team found that the systems inspected were generally free of corrosion, oil leaks, water leaks, and trash, and based on their external condition, appeared to be appropriately maintained. Most obvious deteriorating conditions had been identified by licensee personnel. Some exceptions are noted below.

- A clear plastic cover for Diesel-Driven Fire Pump B battery bank was broken.
- Turnbuckle-tensioned structural cross braces, in the structure housing the site fire pumps, were in contact with frames that contained sets of automatically-controlled louvers for admitting outside air to the building. This interference created a potential to distort the frames and impact operation of the louvers.
- The jockey fire pump had excess packing leakage. Green polyethylene sheeting had been used to prevent leakage dispersal into the atmosphere.
- The electric-driven fire pump drive coupling was leaking oil or grease.
- There were minor oil and water leaks on the feedwater pumps.

The licensee was informed of the above unreported deficiencies and took initial action to evaluate or schedule corrective maintenance as necessary.

c. Conclusions

The observed structures, systems, and components were generally in good material condition with the exception of certain fire protection equipment.

M7 Quality Assurance in Maintenance Activities

M7.1 Licensee Self Assessment

a. Inspection Scope (62706)

The team reviewed a total of seven self assessments, listed in the attachment, that had been performed on the licensee's Maintenance Rule program between June 1994 and March 1997.

b. Observations and Findings

Four of the self assessments were conducted by the licensee, the other three also involved either a peer group, consultants, or both. The first six assessments only addressed portions of the licensee's program. The seventh assessment, which was completed in March 1997, was a comprehensive assessment of the licensee's Maintenance Rule program.

All the assessments appeared to thoroughly assess the areas of the audit and identified appropriate concerns and recommendations. The March 1997 assessment was particularly in-depth and identified numerous areas for the licensee to improve the Maintenance Rule program.

The team reviewed a sample of the licensee's corrective actions in response to the two latest assessments. The licensee appeared to have taken appropriate actions in all cases.

Although problems were identified and corrected through the licensee's self assessment process, the self assessments did not identify all of the problems identified by the NRC team.

c. Conclusions

The team concluded that self assessments were detailed and addressed areas of Maintenance Rule implementation, and the self assessments identified concerns and recommendations. The licensee's corrective actions appeared appropriate for the problems identified. However, the self assessments did not identify all of the problems identified by the NRC team.

III. Engineering

E4 Engineering Staff Knowledge and Performance

E4.1 Engineers' Knowledge of Maintenance Rule

a. Inspection Scope (62706)

The team interviewed engineering personnel to assess their understanding of the Maintenance Rule and associated responsibilities. The team also reviewed the training that had been administered to system engineering personnel.

b. Observations and Findings

The system engineers displayed a satisfactory overall knowledge level with respect to their assigned systems' construction, operation, and present condition or configuration. Their specific knowledge level regarding Maintenance Rule activities was minimal. The team noted that approximately 2 to 3 hours of training pertaining to Maintenance Rule activities had been provided over the last year. The team also noted that the system engineers had little knowledge of probabilistic risk analysis insights as applicable to their systems. Formal training had not been provided to system engineering personnel regarding probabilistic risk analysis and its applications in monitoring the effectiveness of maintenance. However, the licensee's program assigned minimum responsibility to individual system engineers. The team determined that the system engineers displayed a knowledge level consistent with their responsibilities as delineated in Procedure PDP-ZZ-00020. Their primary responsibility was to evaluate potential functional failures.

c. Conclusions

System engineers had sufficient knowledge of their assigned systems. The Maintenance Rule and probabilistic risk analysis knowledge level of individual system engineers was commensurate with their responsibilities as defined in the licensee's program.

V. Management Meetings

X1 Exit Meeting Summary

The team discussed the progress of the inspection on a daily basis and presented the inspection results to members of licensee management at the conclusion of the onsite portion of the inspection on August 22, 1997. In addition, supplemental telephonic exits were held on October 24 and December 19, 1997, following inoffice inspection to discuss the enforcement findings from the inspection. During the meetings, the licensee personnel acknowledged the findings presented.

The team asked the licensee staff and management whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

ATTACHMENT

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

R. Affolter, Plant Manager
T. Antweiler, Maintenance Rule Administrator
G. Belchik, Supervisor, Planning
K. Connelly, Probabilistic Risk Assessment Engineer
G. Czeschin, Training Superintendent
J. Gloe, Maintenance Superintendent
D. Heinlein, Supervising Engineer, System Engineering
J. Laux, Manager, Quality Assurance
J. McGraw, Engineering Superintendent
C. Nasland, Manager, Nuclear Engineering
M. Reidmeyer, Engineer, Licensing Quality Assurance
P. Shannon, Operating Supervisor
M. Taylor, Assistant Manager, Work Control

NRC

R. Correia, Chief, Maintenance Reliability Section
D. Passehl, Senior Resident Inspector
D. Powers, Chief, Maintenance Branch

INSPECTION PROCEDURES USED

IP 62706	Maintenance Rule

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-483/9711-01	NOV	Failure to validate reliability performance criteria (Section M1.2.b).
50-483/9711-02	NOV	Inadequate process for monitoring reliability of safety significant structures, systems, and components (Section M1.6).
50-483/9711-03	NOV	Failure to adequately monitor performance of preventive maintenance program (Section M1.6).

LIST OF PROCEDURES REVIEWED

PDP-ZZ-00020	Maintenance Rule Program, Revision 2
APA-ZZ-00303	Classification of Systems, Revision 3
APA-ZZ-00310	Workman's Protection Assurance and Caution Tagging, Revision 11
APA-ZZ-00500	Corrective Action Program, Revision 27
ESP-ZZ-01013	Maintenance Rule Structures Inspection, Revision 1
ODP-ZZ-00002	Equipment Status Control, Revision 14
PDP-ZZ-00006	Preparation of the Daily and Weekly Schedule, Revision 8
ISF-SB-00A29	I&C Functional Test Surveillance, Revision 18
OSP-SB-0001A	Reactor Trip Breaker A TADOT, Revision 6
OSP-SB-00003	Reactor Trip - Turbine Trip (P-4) TADOT, Revision 1
OSP-SB-C0001	Reactor Trip Breaker P-4 Verification, Revision 2

LIST OF DOCUMENTS REVIEWED

SP94-033	QA Surveillance of Maintenance Rule Program, June 1994
AP94-016	QA Audit of Maintenance Rule Program, September 1994
SP95-057	QA Surveillance of Maintenance Rule Program, June 1995
N/A	NEI/Peer Group Assessment of Callaway Maintenance Rule Program, July 1995
SP96-041	QA Surveillance of Maintenance Rule Program, May 1996
SP97-006	QA Surveillance of Maintenance Rule Program, January 1997
N/A	Consultant/Peer Group Assessment of Callaway Maintenance Rule Program, March 1997
N/A	List of Structures, Systems, and Components Within the Scope of the Callaway Maintenance Rule Program
N/A	List of Structures, Systems, and Components Not Within the Scope of the Callaway Maintenance Rule Program and Justification for Exclusion
N/A	Justification for the Exclusion of Significant Structures from the Scope of the Callaway Maintenance Rule Program
N/A	Background Explanation for Systems Assigned to Category (a)(1)
N/A	Current Maintenance Rule Trending Data
N/A	List of Maintenance Rule Functional Failures for Fuel Cycles 7 and 8

N/A	List of Maintenance Rule Maintenance Preventable Functional Failures for Fuel Cycles 7 and 8
NES 96-209	Engineering Report on Feedwater Heater Tube Bundle Failures

Suggestion Occurrence Solution Reports

93-0256	95-1422	96-0086	96-1247
93-2056	95-1475	96-0110	96-1336
94-0050	95-1477	96-0180	96-1349
94-0474	95-1487	96-0260	96-1621
94-0674	95-1491	96-0442	96-1814
94-0939	95-1535	96-0450	96-1864
94-1007	95-1549	96-0548	96-1894
94-1059	95-1599	96-0625	97-0213
94-1109	95-1655	96-0670	97-0295
94-1111	95-1666	96-0724	97-0372
94-1328	95-1682	96-0732	97-0555
94-1471	95-1684	96-0764	97-0558
95-0189	95-1692	96-0953	97-0615
95-0508	95-1706	96-1026	97-0693
95-0924	95-1885	96-1027	97-0696
95-1119	95-1996	96-1047	97-0717
95-1130	95-2013	96-1048	97-0787
95-1132	95-2113	96-1053	97-0852
95-1256	95-2128	96-1055	97-0870
95-1283	95-0450	96-1103	97-0986
95-1403	96-0004	96-1192	

Drawings

M-22AF01, Revision 16
M-02AL01, Revision 17
M-22GN01, Revision 14
M-22EMO1, Revision 16
M-22EMO2, Revision 12

System Descriptions

M-00AF, Revision 4
M-00AL, Revision 5
M-00GN, Revision 5

Work Orders/Requests

170479
171547
173845
177299
178822
178823
178824
179873
179921
182050
570805
593094